Atmospheric delivery of bioavailable iron from sparsely vegetated areas to the Southern Ocean

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Atmospheric deposition of dust source materials is a significant source of exogenous iron (Fe) in marine ecosystems to sustain phytoplankton blooms. This process is particularly important to the Southern Ocean, which is arguably the most biogeochemically important ocean because of its large spatial extent and its considerable influence on the global carbon cycle. However, there is large uncertainty in estimates of dust emissions in the Southern Hemisphere, and thus of the deposition of Fe-containing aerosols onto the ocean. Here, we use an atmospheric chemistry transport model to estimate the emission, transport, chemical aging, and subsequent deposition of soluble Fe. We do so using a physically-based dust emission parameterization to better capture seasonal variability in dust emission. We evaluate the simulated aerosol optical depth (AOD) using ground-based sun photometer (AERONET) measurements near dust source regions. Our improved model results suggest that Fe input into the Southern Ocean would increase significantly from austral spring to summer. Our model results indicate that the dust emissions from open shrublands in arid and semi-arid regions are a key contributor to Southern Hemispheric dust.